

CMEIG Engineering Working Group

National Construction Equipment Convention (NCEC)

Sydney, Australia

16th November, 2018

Presented by

***Osama Ali** (Caterpillar) and **Chris Morley** (Hitachi)*



The Construction & Mining Equipment Industry Group (CMEIG) is a non-profit organisation to represent the construction and mining equipment industry and allied equipment and services on issues impacting on the delivery of business.

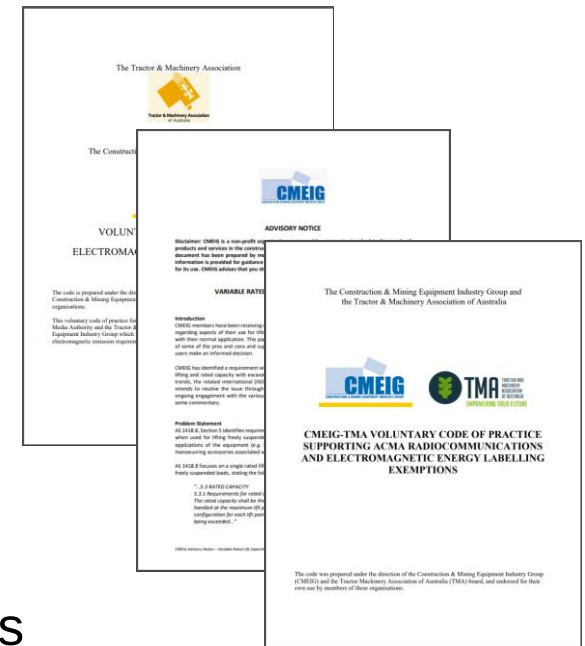
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Agenda

- EWG Introduction
- Activity 'snapshot'
 - Standards Development Activities
 - Access systems
 - Rubber tired equipment, in-service brake testing
 - CMEIG Papers
 - Rated Load Measurement for Wheel Loaders
 - Rated Capacity Indicators for Tracked Excavators
- Questions/Comments

Engineering Working Group

- A 'branch' of CMEIG
- Technical SME's from various CMEIG members
- Group aim:
 - Represent the industry on various committees & forums
 - Liaise with regulatory bodies in all States/Territories
 - Promote standards and regulations harmonisation
 - Advise on technical issues relating to construction and mining equipment
- Publications, presentations, advisory documents, regulatory instruments
 - www.cmeig.com.au/working-groups/engineering



Standards Development Activities

Standards Development - Access Systems

- EMM access to the operator station and routine maintenance
 - Handrails, Guardrails, Steps, Ladders, Doors, Openings etc.
- Burning platform
 - Issue of varying sources of reference currently in Australia

INTERNATIONAL STANDARD ISO 14122-1

Second edition 2016-06-01

Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means and general requirements of access

Sécurité des machines — Moyens d'accès permanents aux machines — Partie 1: Choix d'un moyen d'accès et des exigences générales d'accès

INTERNATIONAL STANDARD ISO 2867

AS 3868—1999

Fixed platforms, walkways, stairways and ladders—Design, construction and installation

Australian Standard®

Earth-moving machinery—Design guide for access systems

AS 1657—2013

Australian STANDARD

Fixed platforms, walkways, stairways and ladders—Design, construction and installation

EMESRT

NSW Resources Regulator

Mobile and transportable plant for use on mines and petroleum sites

Mining Design Guidelines | MDG 15

This guide does not apply to mobile and transportable plant for use at underground coal mines

Symbol	Description	Dimension	
		Min.	Target
A	Platform width	300 ^a	800
	Walkway width	300 ^a	600
	Passageway width — Forward-facing passage of user ^c	550	650
D	Head clearance — Standing	2000 ^a	2000
	Head clearance — Kneeling ^d	1000 ^a	1000
C	Guardrail height	1000	1000
E	Foot barrier height	1000	1000
F	Foot barrier to floor clearance	1000	1000
G	Platform width — Less than 2 m height	1000	1000

^a Minimum width A is dependent on head clearance. B, a graph at right.

^b See 6.3.1.

^c Use target dimension as minimum for crawling.

^d For routine maintenance points only.

^e See 6.3.1 and 6.3.2.

Symbol	Description	Dimension	
		Min.	Target
A	Ladder or step — Handrail diameter (or width across flats)	15 ^a	25
B	Stairway, walkway, platform or ramp — Handrail diameter (or width across flats)	15	50
C	Hand clearance to mounting surface	50	75
D	Distance above standing surface or ground	—	1 100
E	Vertical distance of handrail continuation above step, platform, stairway or ramp	850	1 100 ^f
F	Offset distance of handrail or handhold from edge of ladder/steps (if ladder/steps and handrail are separate parts)	50	200
G	Ladder — Width between parallel handrails	300 ^a	600
H	Stairway and ramp — Width between parallel handrails	400	700
I	Distance above walkway, passageway, step or stairway step	850	1 400 ^a
J	Forward reach to handhold from the ground, step, platform or walkway	—	785

^a 10 mm if orientation is vertical and the standing position for the handrail or handhold is greater than 3 m above the ground.

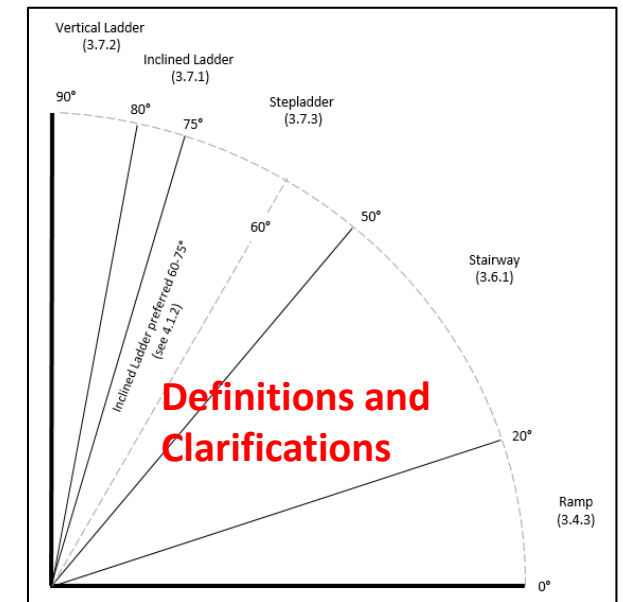
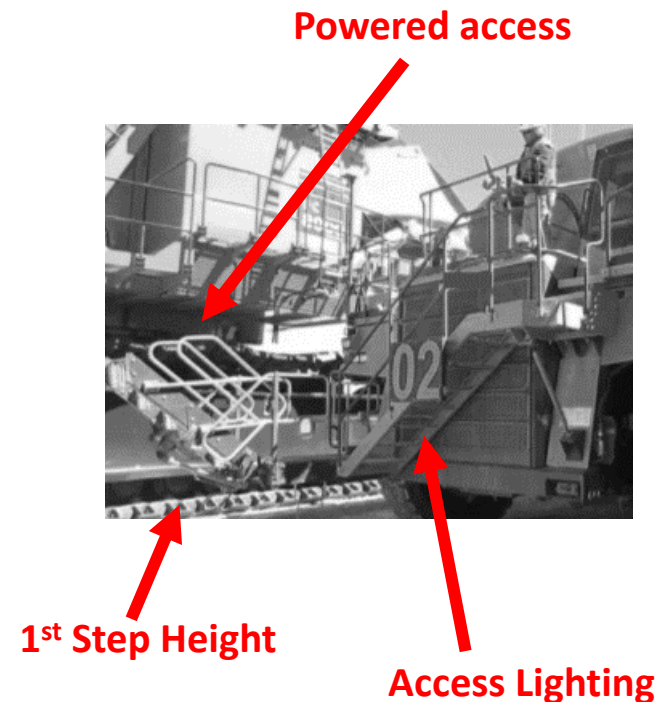
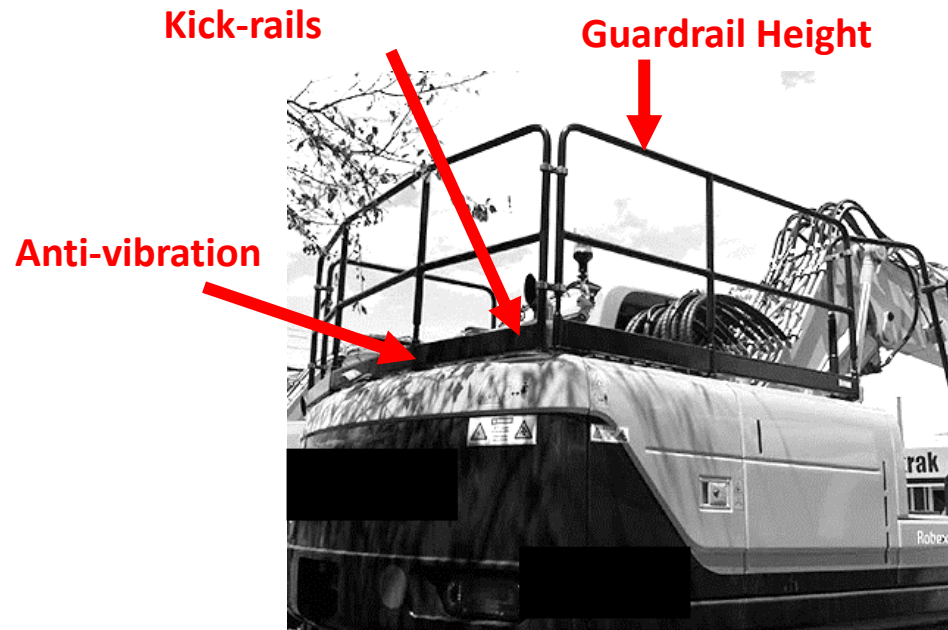
^b Up to 1 100 mm maximum when the handrails/handholds are an integral part of a door opening.

^c May be increased to 1 700 mm for handrails and handholds located above the cab door.

^d 300 mm up to a maximum height of 450 mm (see J), over 450 mm height, a width of 450 mm is required.

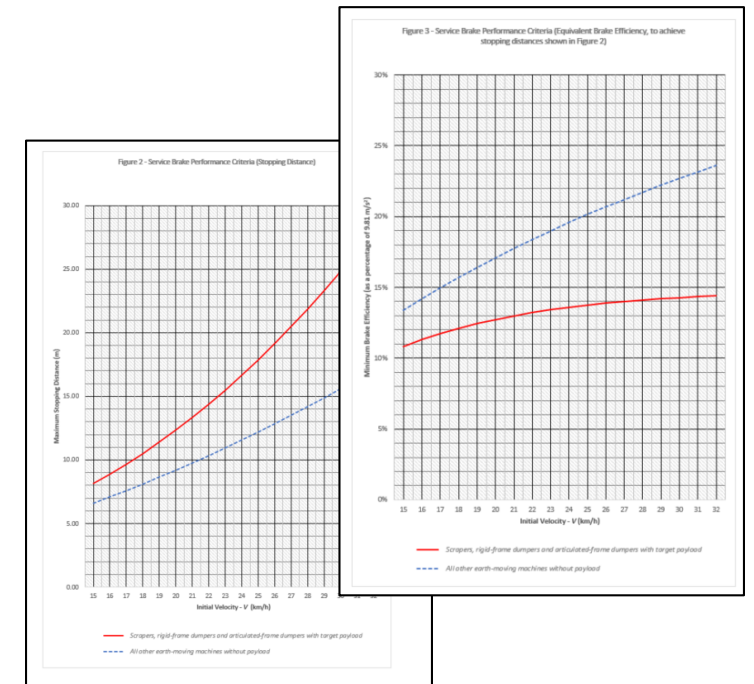
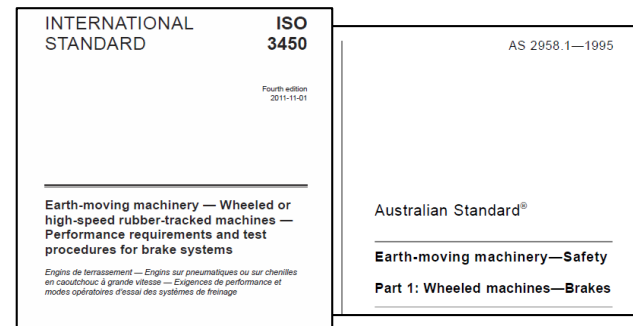
Intent – Additional Clarity for Access Systems Design

- Project underway to re-align and provide design clarity
 - 5-6 Disparate references → 1 document
 - More detailed guidance in specific areas
 - Public comment



Standards Development - Brake Testing

- Existing drivers (in specific applications) for in-service dynamic brake testing
- Limited guidance
 - Extensive sources of real-world variability
 - Vague pass/fail criteria
- Currently a work in progress
 - Re-alignment of similar AS and ISO standards
 - Practicable guidance for in-service brake testing
 - Objective pass/fail criteria



CMEIG Paper

Measurement of Rated Load for Wheel Loaders

Different standards

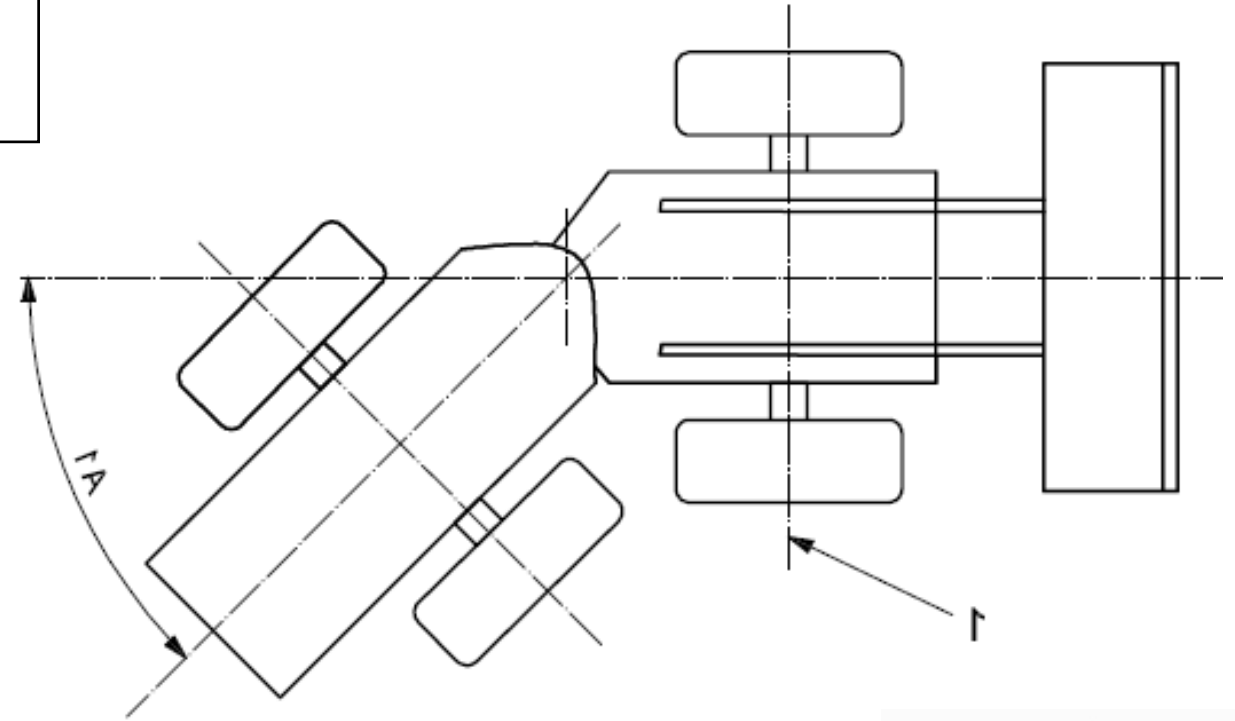
- No current Australian Standard for determining rated load for wheel loaders
- Different international standards, eg.:
 - **ISO 14397-1:2007** *Earth-moving machinery - Loaders and backhoe loaders - Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load*
 - **ISO 20474-3:2017** *Earth moving machinery – Safety – Part 3: Requirements for loaders*
 - **EN 474-3:2006** *Earth-moving machinery – Safety – Part 3: Requirements for loaders*
 - **SAE J1197-2011** *Rated Operating Load for Loaders Equipped with Log or Material Forks without Vertical Mast*
 - **(Withdrawn) SAE J818-2007** *(Rated Operating Load for Loaders)*

General Principles

- Rated load usually determined by:

$$\begin{array}{ccc} m_{\text{tip}} & & k \\ \text{(tipping load*)} & \times & \text{(stability factor)} \\ \text{*under certain conditions} & & \end{array}$$

- Configuration most likely to tip
- Include:
 - Mass of load and material density
 - Location of CofG
 - Mass of attachment and coupler
- Variables and conditions, for example:
 - Ground condition (firm and level, rough terrain)
 - Maximum speed of travel
 - Tyre compressibility (rigid vs flexible)



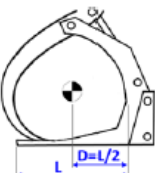
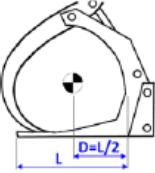
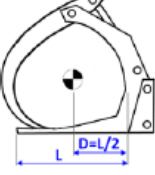
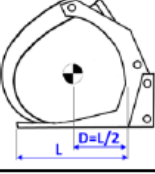
Example – Fork Applications

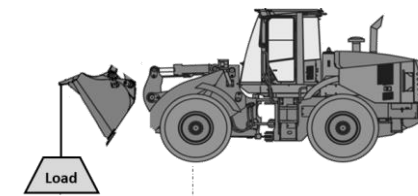
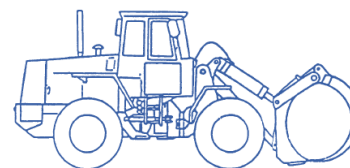
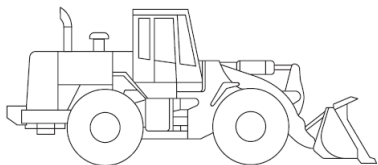
Standard	Operating surface	Factor	Max. travel speed
ISO 14397-1:2007	Hard substantially smooth and level	50% tipping load, or 100% hyd capacity	15 km/h
ISO 20474-3:2017	Rough terrain	60% tipping load, or 100% of hyd capacity	15 km/h
	Firm and level ground	80% tipping load, or 100% of hyd capacity	15 km/h
EN 474-3:2006	Rough terrain	60% tipping load, or 100% of hyd capacity	15 km/h
	Firm and level ground	80% tipping load, or 100% of hyd capacity	15 km/h
SAE J1197-2011	Hard, moderately smooth and level	50% tipping load, or 100% hyd capacity	6 km/h

Specific Applications Addressed

- Bucket applications
- Fork applications
- Log handling applications
- Heavy single object
 - (non palletised) applications
- Lifting freely suspended loads
 - (Australian Standard exists)

Table 3 – Rated Loads for Log Handling Applications

Standard	Terminology	Operating surface	Description	Max. travel speed	Load Centre of Gravity (C.O.G.) location
ISO 14397-1:2007 <i>Log Handling is not specifically mentioned.</i>	Rated Operating Capacity	Hard, substantially smooth and level	50% of tipping load, or 100% of hydraulic capacity (whichever is the lesser).	15 km/h	Grab tynes must be horizontal with clamp closed $L = \text{grab tyne length}$ 
ISO 20474-3:2017	Rated Operating Capacity	Rough terrain	75% of tipping load, or 100% of hydraulic capacity (whichever is the lesser).	15 km/h	Grab tynes must be horizontal with clamp closed $L = \text{grab tyne length}$ 
		Firm and level ground	85% of tipping load, or 100% of hydraulic capacity (whichever is the lesser).		
EN 474-3:2006	Rated Operating Capacity	Rough terrain	75% of tipping load, or 100% of hydraulic capacity (whichever is the lesser).	15 km/h	Grab tynes must be horizontal with clamp closed $L = \text{grab tyne length}$ 
		Firm and level ground	85% of tipping load, or 100% of hydraulic capacity (whichever is the lesser).		
SAE J1197:2011	Rated Operating Load	Hard, moderately smooth and level	50% of tipping load, or 100% of hydraulic capacity (whichever is the lesser).	6 km/h	Grab tynes must be horizontal with clamp closed $L = \text{grab tyne length}$ 



Purpose of CMEIG Paper

- Clarify main differences between main standards
- Update on previous CMEIG advisory
- Does NOT replace details contained in standards
- Ready quick reference
- Available on CMEIG website

CMEIG
CONSTRUCTION & MINING EQUIPMENT INDUSTRY GROUP

ADVISORY NOTICE

Disclaimer: CMEIG is a non-profit organization sponsored by products and services in the construction and mining equipment industry. The information provided is for guidance only and no legal liability can be accepted by CMEIG. You should seek appropriate specialist advice to confirm your requirements.

RATED LOADS FOR WHEEL LOADERS

The aim of this information paper is to clarify the main differences between the standards for rated loads for wheel loaders (as distinct from crawler loaders). Load mass, material density, centre of gravity, as well as the method of calculation, are all factors that influence the rated load. It is important to understand which standard has been applied as it may affect the conditions under which a wheel loader is used. It is also important to understand there may be assumptions made in the standards.

a) Linkage position used for calculating rated load (e.g. for pallet fork & logging grapple).

b) Consideration of all relevant hydraulic functions of each function.

c) Assumptions made in relation to the linkage position:

- o 'Rigid Tie' i.e. Front axle on the ground.
- o 'Flexible Tie' i.e. Modelling the front axle as a spring.

A comparison of the various applications is provided in subsequent pages of this advisory notice.

For specific questions or queries, contact your nearest CMEIG office.

BUCKET APPLICATIONS

Rated load for wheel loaders fitted with buckets is covered by the following standards:

- ISO 14397-1:2007 Earth-moving machinery – Loaders and backhoe loaders – Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load.
- ISO 20474-3:2017 Earth moving machinery – Safety – Part 3: Requirements for loaders.
- EN 474-3:2006 Earth-moving machinery – Safety – Part 3: Requirements for loaders.

Additional notes:

- There are currently no Australian standards that cover rated loads for wheel loaders fitted with buckets.
- Both ISO 20474-3:2017 and EN 474-3:2006 simply refer to ISO 14397-1:2007 for rated operating capacity for wheel loaders fitted with buckets.
- The following standards have been withdrawn or cancelled:
 - AS 2954.1:1988 Earth-moving machinery – Rated loads and volumetric ratings – Rated

Table 4 – Rated Loads for Heavy Single Object (HSO) Applications (non-palletised load)

Standard	Terminology	Operating surface	Description	Max. travel speed	Load Centre of Gravity (C.O.G.) location									
ISO 14397-1:2007	Rated Operating Capacity	Firm and level ground	80% of tipping load, or 100% of hydraulic capacity (whichever is the lesser). Note: see Standard for additional requirements (e.g. load fully rolled back, load as low as possible).	2 km/h	<table border="1"> <thead> <tr> <th>Load (kg)</th> <th>X (mm)</th> <th>Y (mm)</th> </tr> </thead> <tbody> <tr> <td><10,000</td> <td>600</td> <td>500</td> </tr> <tr> <td>>10,000</td> <td>900</td> <td>600</td> </tr> </tbody> </table>	Load (kg)	X (mm)	Y (mm)	<10,000	600	500	>10,000	900	600
Load (kg)	X (mm)	Y (mm)												
<10,000	600	500												
>10,000	900	600												
ISO 20474-3:2017	Rated Operating Capacity	Firm and level ground	80% of tipping load, or 100% of hydraulic capacity (whichever is the lesser). Note: see Standard for additional requirements (e.g. load fully rolled back, load as low as possible).	2 km/h	<table border="1"> <thead> <tr> <th>Load F (N)</th> <th>D (mm)</th> </tr> </thead> <tbody> <tr> <td>F < 100,000</td> <td>600</td> </tr> <tr> <td>100,000 ~ 200,000</td> <td>900</td> </tr> <tr> <td>F > 200,000</td> <td>1,200</td> </tr> </tbody> </table>	Load F (N)	D (mm)	F < 100,000	600	100,000 ~ 200,000	900	F > 200,000	1,200	
Load F (N)	D (mm)													
F < 100,000	600													
100,000 ~ 200,000	900													
F > 200,000	1,200													
EN 474-3:2006	Rated Operating Capacity	Flat hard surface	80% of tipping load, or 100% of hydraulic capacity (whichever is the lesser). Note: see Standard for additional requirements (e.g. load fully rolled back, load as low as possible).	10 km/h	<table border="1"> <thead> <tr> <th>Load F (N)</th> <th>D (mm)</th> </tr> </thead> <tbody> <tr> <td>F < 100,000</td> <td>600</td> </tr> <tr> <td>100,000 ~ 200,000</td> <td>900</td> </tr> <tr> <td>F > 200,000</td> <td>1,200</td> </tr> </tbody> </table>	Load F (N)	D (mm)	F < 100,000	600	100,000 ~ 200,000	900	F > 200,000	1,200	
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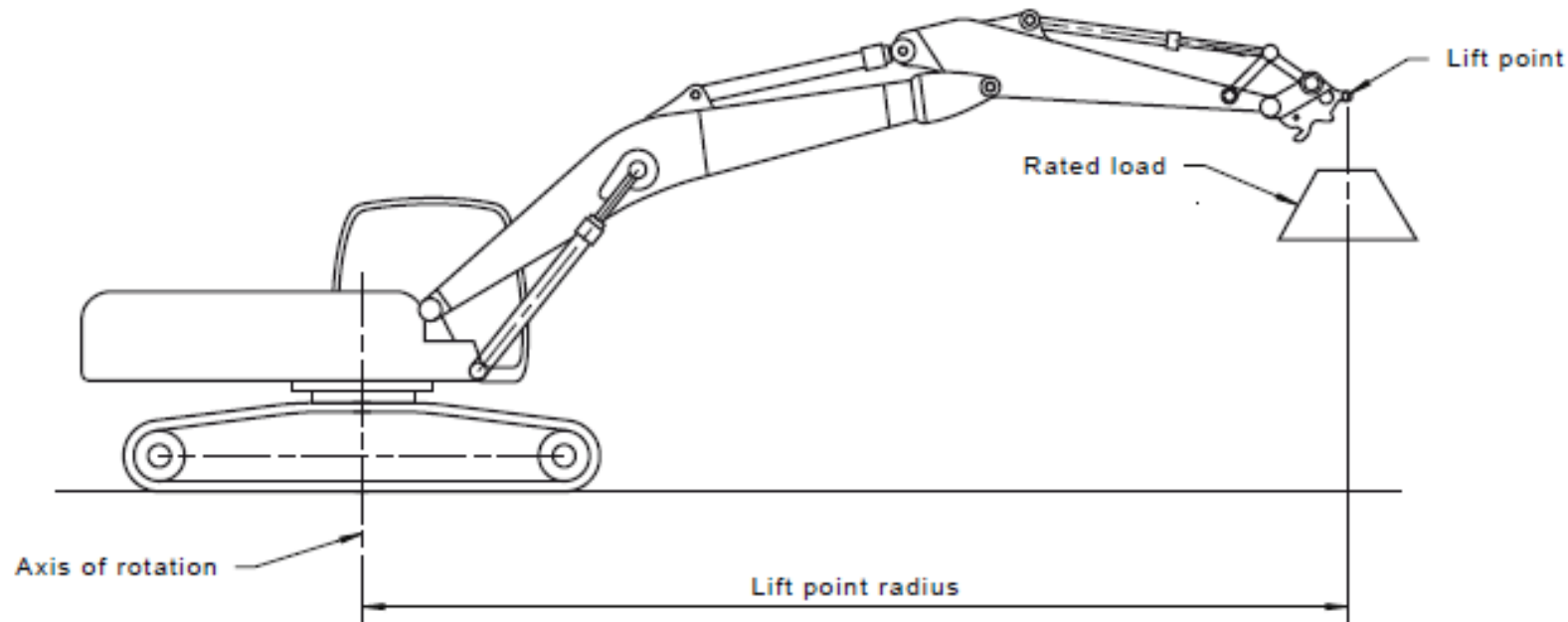
CMEIG Advisory Notice – Rated Loads for Wheel Loaders – October 2020

CMEIG Paper

Variable Load Lifting with Tracked Excavators

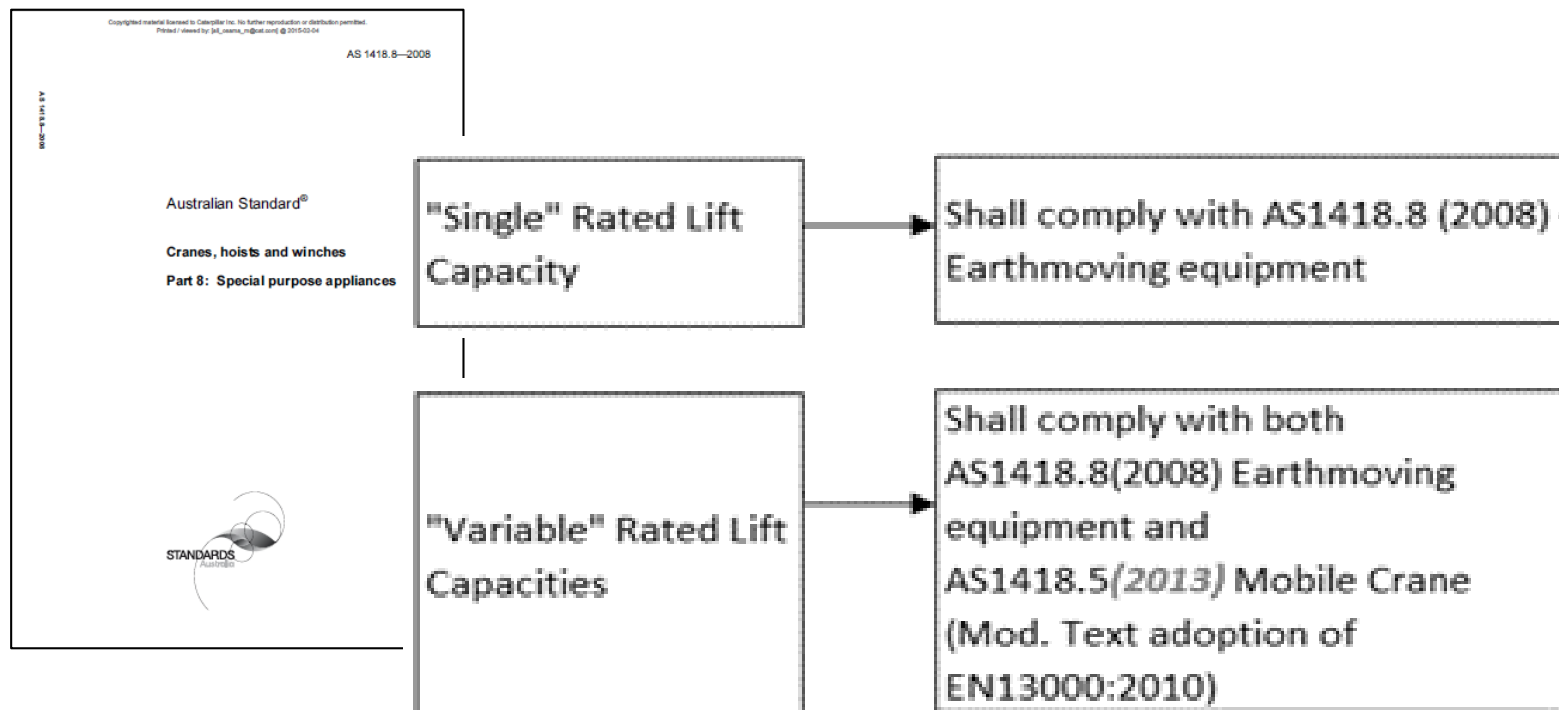
Variable Load Lifting – Tracked Excavators

- Relates to lifting freely suspended loads as a secondary function associated with the normal THEX applications:
 - lifting and moving pipes
 - unloading construction equipment
 - manoeuvring accessories associated with the equipment



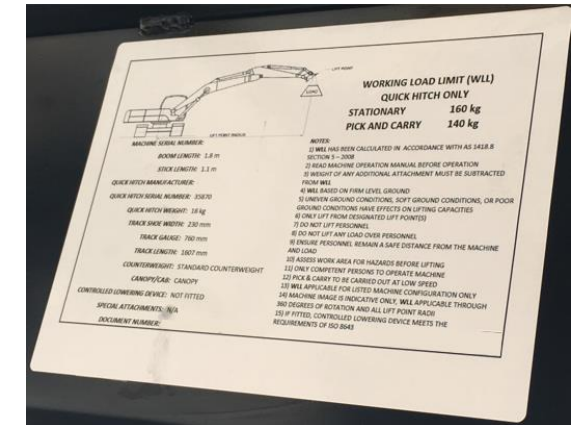
Burning Platform

- Source of ongoing inquiries to CMEIG members
 - *AS 1418.8, Section 5*



How This Plays Out Today...

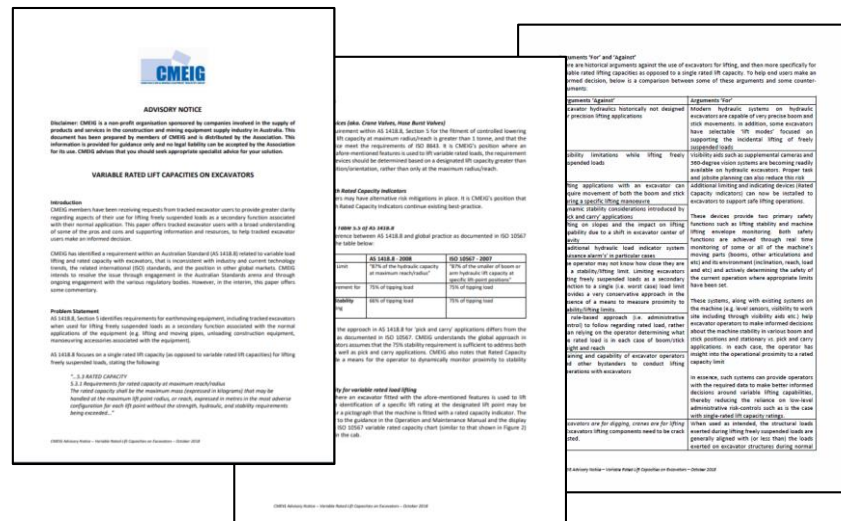
	1.5 m (5.0 ft)		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		7.5 m (25.0 ft)			
												m ft
7.5 m 25.0 ft	kg lb											
6.0 m 20.0 ft	kg lb											
4.5 m 15.0 ft	kg lb											
3.0 m 10.0 ft	kg lb											
1.5 m 5.0 ft	kg lb											
Ground Line	kg lb											
-1.5 m -5.0 ft	kg lb											
-3.0 m -10.0 ft	kg lb											
-4.5 m -15.0 ft	kg lb											



Detail	AS 1418.8 - 2008	ISO 10567 - 2007
Rated Hydraulic Capacity Limit	"87% of the hydraulic capacity at maximum reach/radius"	"87% of the smaller of boom or arm hydraulic lift capacity at specific lift-point positions"
Stationary Stability Requirement for Load Rating Condition	75% of tipping load	75% of tipping load
Pick and Carry (General) Stability Requirement for Load Rating Condition	66% of tipping load	75% of tipping load

Purpose of CMEIG paper

- Number of historical drivers for these differences in position
 - Advises on how new technologies can address some of these historical drivers
- AU Approach inconsistent with ROW



Questions / Comments?

- <https://www.cmeig.com.au>
- Working Groups
- **Engineering**

